

Waste Acceptance Criteria

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**Environmental Protection Department
Radioactive and Hazardous Waste Management Division**

Waste Acceptance Criteria

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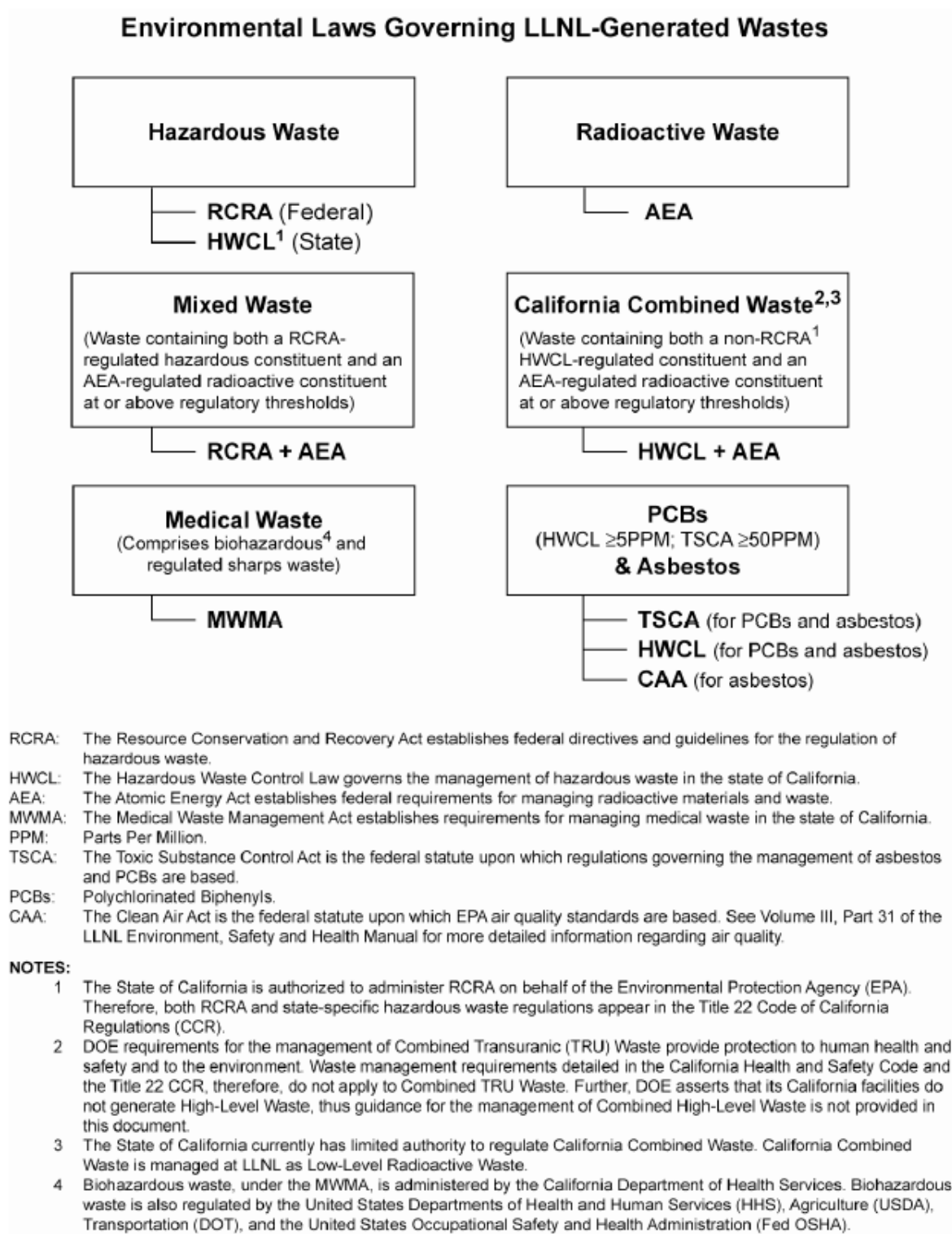
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1.0 Introduction

This Waste Acceptance Criteria (WAC) provides waste handling guidance to Lawrence Livermore National Laboratory (LLNL) waste generators and documents a plan for compliance with applicable State and Federal regulations. The WAC is written and maintained by the Radioactive and Hazardous Waste Management (RHWM) Division of the Environmental Protection Department (EPD) of LLNL. The WAC is a summary of information from other approved documents and may be found online at <http://www-hwmpdc.llnl.gov/P&DC/Informational Docs/Waste Acceptance Criteria/>.

The RHWM Division provides assistance to LLNL waste generators in the safe handling and packaging of waste generated as a part of normal work activities at LLNL. RHWM operates several waste handling facilities at LLNL that are regulated by both state and federal guidelines. Many of the requirements outlined in the WAC are mandated by these regulations while others are dictated by offsite waste disposal requirements. Figure 1 summarizes the regulatory mandates that LLNL is obligated to follow in managing its waste.

Figure 1. Excerpt from *ES&H Manual*, Document 36.1.

1.1 Purpose

This RHW M WAC summarizes waste handling requirements for waste generators and provides the waste generator with guidance on waste acceptance protocols for waste generated at LLNL.

The intent of this WAC is to provide waste acceptance criteria for waste accepted into LLNL's RHW M treatment, storage, and disposal facilities as well as for waste being transferred to offsite disposal facilities.

1.2 Scope

This WAC provides guidance on the management of waste at LLNL to ensure compliance with the Hazardous Waste Facility Permit Operation Plan and the Documented Safety Analysis (DSA) for the Waste Storage Facilities. In addition, this WAC discusses waste identification, labeling, and packaging; waste documentation; and life-cycle planning.

This WAC does not apply to waste generated at LLNL Site 300.

1.3 Responsibilities

The Waste Generator, RHW M Technician, RHW M Radiological Characterization Analyst (RCA), RHW M Characterization Chemist (CC), and ES&H Environmental Analyst (EA) all take part in making waste determinations. Responsibilities are summarized below and are discussed in detail in the *ES&H Manual*, Document 2.1, "General Worker Responsibilities and Integrated Safety Management", Appendix D.

1.3.1 Waste Generator Responsibilities:

The **Waste Generator** uses information obtained through required training and process knowledge to determine if any constituents in a waste potentially exhibit any hazardous properties to ensure that the correct hazardous properties are initially identified during waste generation. Once the waste is generated, the Waste Generator works with the RHW M Technician to decide if analytical testing is needed to further characterize the waste constituents and determine the concentrations. Waste Generator responsibilities are outlined below.

- The Waste Generator must complete the required training. Specific training is discussed in Section 1.4 below.
- Prior to the generation of any type of waste, the Waste Generator must identify the type(s) of waste to be generated, and coordinate required actions with the RHW M Technician. This information is documented on the *Information Gathering Document* (IGD), (WGS 0002). Life Cycle Planning information is also assessed and documented on the IGD.
- The Waste Generator must place or accumulate the waste in the appropriate containers. Waste Generators supply their own waste containers.

- The Waste Generator must properly identify and handle the waste generated and provide RHWL representatives with sufficient information to allow for safe handling and management of the waste.
- The Waste Generator must notify the RHWL Radiological Characterization Group (RCG) Leader or designee prior to the generation of any new waste with a radioactive component.
- The Waste Generator must ensure that the work environment is safe for the RHWL Technician when he or she is working in area of responsibility. This may include providing a knowledgeable individual to accurately identify the waste generation process, expected waste components, and their hazardous, mixed, or radioactive characteristics, and providing a knowledgeable person to work with the RHWL Technician when two people are required for certain operations.
- The Waste Generator is required to sign a Waste Disposal Requisition (WDR) or delegate signature authority to a qualified designee who is current in all Waste Generator training requirements.

A **Limited Generator** is an individual who contributes waste to a container in a Satellite Accumulation Area (SAA) but does not sign the WDR. A Limited Generator is required to have training specific to the job activity. The Limited Generator ensures that the waste is accurately identified including the composition, the matrix, the hazardous and radioactive constituents, and the amounts of each constituent in the container.

1.3.2 RHWL Division Responsibilities:

RHWL Division Personnel involved in making waste determinations manage waste from generation to disposal in a safe manner, protective of the worker, the public, and the environment. They perform waste characterization activities based on information provided by the Waste Generator. Note that characterization is an activity that occurs subsequent to waste identification by the Waste Generator to ensure proper treatment, storage, and disposal.

The **RHWL Technician** works with the Waste Generator to ensure that wastes are properly identified, sampled, packaged, and removed from the SAA and/or Waste Accumulation Area (WAA) within the required time limitations. The RHWL Technician serves as an interface between RHWL and the Waste Generator and is responsible for assisting the Waste Generator with proper management of wastes. These duties include logging WDR information into the RHWL database, completing a Fingerprint Verification Analysis Checklist (FVAC) if applicable, performing sampling and field analysis, and managing SAAs and WAAs.

The **RHWL RCA** ensures that the waste container does not exceed fissile material limits and assists the Waste Generator in identifying radioactive waste constituents and concentrations by arranging for certified or non-certified laboratory analyses.

The **RHWM CC** ensures that the appropriate information is entered into the RHWM waste tracking database; ensures that the container does not exceed single container inventory limits (SCIL); assists the Waste Generator in identifying waste constituents and concentrations by arranging for certified or non-certified laboratory analyses; assigns required regulatory waste codes; and hazardous (toxic, corrosive, ignitable, or reactive) property designators.

Requisitions Control Office (RCO) Personnel maintain control of waste documentation and issue waste container labels.

RHWM Management provides trained personnel to assist Waste Generators including providing retention tank management, WAA operations (including transport of waste containers to WAA or Consolidation WAA), and any required waste sampling and field analyses and addresses hazards associated with the RHWM Technician's work activities.

1.3.3 Environmental Analyst Responsibilities

The EA provides guidance to LLNL programs and organizations regarding waste management requirements. The EA may assist waste generators in the identification of waste type and may assist in the determination of hazardous properties.

1.4 Generator Training

EPD provides training for waste generators at LLNL to ensure that Waste Generators are knowledgeable in the safe handling of waste. The training is required by Federal and State waste regulations. The Waste Generator's line management is responsible for ensuring that all required training has been completed. RHWM will not accept waste from a Waste Generator whose training is not current. Annual refresher training is required for all waste courses. These courses are offered on-line at the EPD Training Program's web site at:

<http://www-r.llnl.gov/EPTP/eptraining/>

Except for workers defined as limited generators (see section 1.3.1 above), any worker who generates hazardous waste must complete the following courses:

EP0006-COR Regulated Waste Management Core Training
EP0006-HZ Hazardous Waste Management Module

Course EP0006-HZRW Hazardous Waste Management Module Refresher must be completed annually thereafter.

Workers who generate waste containing radioactive components must complete the following courses.

EP0006-RD Radioactive Waste Management Module

Course EP0006-RDRW Radioactive Waste Management Module Refresher must be completed annually thereafter.

Detailed training information is found in the *ES&H Manual*, Document 40.1, “LLNL Training Program Manual”.

1.5 Radioactive Waste Management Basis

The implementation of this WAC will ensure that radioactive waste management activities at LLNL are conducted in compliance with the requirements of DOE Order 435.1, *Radioactive Waste Management*, as described in the Radioactive Waste Management Basis for LLNL, and the Implementation Guide for DOE Manual 435.1-1, *Radioactive Waste Management Manual*. The DOE Order 435.1 stipulates that no radioactive waste (any waste with a radioactive component) shall be generated unless a disposal path has first been identified. Any exceptions shall be approved by DOE. The DOE policy for radioactive waste specifies requirements for life-cycle planning, waste reduction, treatment, storage, disposal, environmental monitoring, and record keeping. Prior to generating waste, the waste generator shall conduct a life-cycle planning assessment, working with RHWm to determine if a feasible disposal path exists for the proposed waste stream. Life-cycle planning is discussed in Section 3.1.9.

1.6 Exceptions to the WAC

Exceptions to the WAC may be made in certain cases. The process for requesting an exception and the types of exceptions that may be requested are described in sections 1.6.1 through 1.6.3 below.

A generator may request, in writing, an exception from the RHWm Division Leader. The request must identify one or more of the exceptions as described below. Any alternative methods to meet the general intent of the requirement should also be discussed in the exception request.

The RHWm Division Leader or designee will review the exception request and determine the appropriate resolution, based on exception criteria given in the WAC. The WAC identifies the source(s) of each requirement so a determination may be made whether an exception must be approved by RHWm or the Department of Energy (DOE) and/or other regulatory agencies. The RHWm Division Leader or designee will respond in writing, stating whether the exception is granted, rejected, or requires further evaluation.

1.6.1 RHWm-Approved Exceptions

An exception to the WAC may be granted if it is demonstrated that the exception does not affect compliance with any applicable regulations and any DOE and/or regulatory agency-approved requirements. This information is documented by RHWm in accordance with RHWm Procedure WIC 117, *Life-Cycle Planning*.

1.6.2 DOE-Approved Exceptions

Exceptions to the WAC that could affect compliance with DOE-approved requirements or DOE Orders will require a DOE waiver, DOE approval of a document revision, or other DOE approval. The Waste Generator must provide the appropriate documentation and RHWm will assist the Waste Generator in completing the exception request.

1.6.3 Regulatory Agency-Approved Exceptions

Exceptions to the WAC that could affect compliance with regulations, permit conditions, compliance orders, or other requirements imposed by a regulatory agency must be submitted by DOE or LLNL to the affected regulatory agency. The document requesting the exemption will be prepared by EPD personnel, with input from the Waste Generator.

2.0 Waste Acceptance Requirements

2.1 Waste Types

A waste is any material that has been discarded. A material is considered to be discarded if it is being: disposed of; accumulated, stored, or treated instead of being disposed; has served its intended use and cannot be used without being processed; or is an unusable manufacturing byproduct. The following are the types of waste that are managed at LLNL by RHW under this WAC:

- **Low-Level Waste (LLW)** - Radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, naturally occurring radioactive material, or byproduct material (as defined in Section 11e (2) of the Atomic Energy Act (AEA) of 1954 as amended).
- **Hazardous Waste** - Waste is hazardous, either because it is a listed waste or because it is a characteristic waste. A listed waste contains a specific chemical appearing on the list in 22 CCR 66261.1 – 66261.126, “*Identification and Listing of Hazardous Waste*,” and/or 40 CFR Part 261, *Identification and Listing of Hazardous Waste*. A characteristic waste is one that is toxic, ignitable, reactive, and/or corrosive, as determined by specific criteria in the regulatory codes cited.
- **California-combined Waste** - Waste that contains both radioactive and non-RCRA components that meet state hazardous waste criteria. California-combined wastes are regulated by the AEA and are excluded from hazardous waste regulations at the state and federal levels. California-combined wastes are managed according to radioactive waste management practices. The Work Smart Standards (WSS) applicable to the management of California-combined wastes are DOE Order 435.1, “*Radioactive Waste Management*,” and DOE M 435.1-1, “*Radioactive Waste Management Manual*.”
- **Mixed Waste (LLW or TRU)** - Radioactive waste that also contains a RCRA hazardous constituent. Waste can become mixed because of: (1) being a product of an experiment or procedure; (2) exposure of RCRA hazardous waste to unconfined sources of radioactivity so that the waste becomes radioactive; or (3) improper waste segregation.
- **Transuranic (TRU) Waste** - Radioactive waste containing >100 nanoCuries (3700 Becquerels) of alpha emitting transuranium radionuclides (nuclides with atomic number > 92) per gram of waste, with half-lives > 20 years.
- **Non-Hazardous Waste** - Waste that contains hazardous constituents below the regulatory limits for hazardous waste but have specific disposal requirements.

2.2 Waste Acceptance Conditions and Requirements (Authorization Basis)

The conditions and requirements for waste acceptance are summarized below. The requirements are based on the DSA for the Waste Storage Facilities and the LLNL Hazardous Waste Facility Permit and Operation Plan.

2.2.1 Radioactive Waste Requirements

Radioactive and California-combined wastes are managed according to radioactive waste management practices. These waste types are regulated by the Atomic Energy Act (AEA) and are excluded from hazardous waste regulations at the state and federal levels. The Work Smart Standards (WSS) applicable to the management of radioactive and California-combined wastes are DOE Order 435.1, *“Radioactive Waste Management,”* and DOE M 435.1-1, *“Radioactive Waste Management Manual”*. In addition, radioactive waste activity and gram limits for RHWM facilities are established by the DSA for the Waste Storage Facilities.

Whenever possible, generators shall physically segregate radioactive waste containers from hazardous waste containers to prevent inadvertent generation of mixed wastes. The EPD follows strict protocols to ensure that radioactive waste meets offsite acceptance criteria. Certification of waste containers is discussed in Section 3.1.10 below.

Radioactive waste is not subject to hazardous waste management accumulation time or quantity limits, however, to ensure proper management, characterization, and disposal of the waste, many of the administrative requirements applicable to hazardous waste are used to manage radioactive waste.

2.2.1.1 Container Limits

Single Container Activity Limits (SCAL) for radioactive wastes must be met for waste acceptance into RHWM facilities. In addition, there are criticality safety controls established for waste with fissile constituents. These limits are found below.

Container Limits for Solid Radioactive Wastes	
All Radionuclides Except Tritium	12 PE-Ci
Tritium	1000 Ci
Container Limits for Liquid Radioactive Wastes	
All Radionuclides Except Tritium	See Appendix A
Tritium	1,000 Ci

2.2.1.2 Criticality Controls

Criticality limits are listed below, however, there are adjustments that may be made to some of the moderator and reflector requirements. Any changes will be made on a case-by-case basis. The RHWMT Technician may be consulted to discuss any possible adjustments that are needed.

Reflectors are substances that are capable of reflecting neutrons back into a system, increasing the reactivity of the system. Chemical elements of high specific density and high atomic number are particularly efficient reflectors.

Moderators are substances capable of slowing down neutrons, making fission reactions more likely. Hydrogen, deuterium, helium, carbon, and beryllium are examples of efficient moderators.

Storage containers are subject to the controls in Table 1, excerpted from the Facility Safety Plan (FSP) for the Waste Storage Facilities and B696S.

Table 1. Storage Container Criticality Safety Controls

Storage Container Type	Storage Container Size	Pu-239 Equivalent Limit (grams)	Moderators/Reflectors			Moderators/Reflectors Allowed in a Container
			Beryllium Limit (grams)	Graphite (carbon) Limit (kilograms)	Nat-U Equivalent (kilograms)	
Fissile	55 gal container equivalent	200 ¹	50 gram waiver amount or less		Nat-U exceeding waiver amount is allowed when its U-235 content is included in the fissile mass limit of 200 grams	N/A
		120	300	8	100	Only 1 type allowed
		65	300	110	100	All 3 types allowed
	30 gal container	80	300	8	100	Only 1 type allowed
	5 gal container equivalent	40	300	8	100	Only 1 type allowed
Nat-U	55 gal container equivalent	1.0	Unlimited	Unlimited	650	All 3 types allowed
	30 gal container	0.6	Unlimited	Unlimited	210	All 3 types allowed
Mixed Array	Any Size	120 ²	Unlimited	Unlimited	300	All 3 types allowed

¹ CSS review is required for each drum exceeding 120 grams Pu equivalent (but less than 200 grams) before these drums can be moved into RHW facilities. Upon CSS review approval, these drums SHALL be handled meeting the criticality safety controls requirements specified in Criticality Safety Administrative Memo (CSAM) 03-167.

² A mixed array is limited to 120 grams Pu equivalent. Therefore, a mixed array drum cannot have more than 120 grams Pu equivalent.

55-gallon Container Equivalent: A container may be equivalent to a 55-gallon drum if the container has a capacity no less than 55 gallons (208 liters) and the smallest dimension is no less than 22.25 inches (56.5 cm). A 55-gallon container equivalent may be handled as a 55-gallon container and be placed in a 55-gallon uniform storage array. A 55-gallon container equivalent includes 85-gallon overpacks and standard waste boxes (SWBs). SWBs includes TRUPACT-II containers and any box with the dimensions of 4-ft x 4-ft x 7-ft, 2-ft x 4-ft x 7-ft, or 2-ft x 2-ft x 7-ft, with its smallest dimensions no less than 60.48 cm (2-feet).

5-gallon Container Equivalent: A container may be equivalent to a 5-gallon container if it is larger than 5 gallons but less than 30 gallons in capacity, with the minimum dimension no less than 28.60 cm (11.26"). Five-gallon containers shall be stacked no more than 4-high with the bottom of the top-level containers no more than 121.92 cm (4') from the ground level.

2.2.2 Hazardous Waste Requirements

The RCRA establishes federal directives and guidelines for the regulation of hazardous waste. The Hazardous Waste Control Law (HWCL) governs the management of hazardous waste in the state of California. The state of California is authorized to administer RCRA on behalf of the Environmental Protection Agency (EPA). Both RCRA and California state-specific hazardous waste regulations appear in Title 22 Code of California Regulations (CCR).

2.2.2.1 Single Container Inventory Limits

Single Container Inventory Limits (SCILs) were established to minimize chemical exposure to off-site individuals. The SCIL is the maximum amount of a specific chemical allowed in any one container. The SCIL list of chemicals is maintained by RHW. Waste containing chemicals in amounts above the SCIL will not be accepted at any RHW facility.

2.2.3 Unacceptable Waste

Some wastes will not be accepted into any RHW facilities. These wastes are described below.

- Explosives will not be accepted.
- Improperly labeled waste containers and incomplete documentation will not be accepted. The RHW Technician initiates a WDR for each waste container.
- Waste that is improperly packaged will not be accepted. Waste in a damaged container, incompatible wastes packaged together, and waste in a container that is incompatible with the waste, are examples of improperly packaged wastes. Specific guidelines for packaging waste are found in section 3.1.2.1 below.
- Shock sensitive wastes that have not been properly inhibited or stabilized will not be accepted. The RHW Technician will test peroxidizable materials for peroxide content and if necessary the waste must be inhibited with a compatible agent, for example, hydroquinone, prior to waste acceptance. Other shock sensitive materials must be hydrated, as applicable. The RHW Technician will provide guidance to Waste Generators in the handling of shock sensitive materials.
- Only waste that is generated at the LLNL Main Site or at LLNL Site 300 will be accepted into RHW facilities.
- Unknowns will not be accepted.
- Wastes which are unstable or reacting will not be accepted. Waste must not be degrading the waste container, emitting gases, or reacting.
- Waste will not be accepted from waste generators who have not completed the required training.

- Waste must be assigned a form code and a source code that are acceptable under the LLNL RCRA Part B Permit for the waste to be accepted. The form code is a designator assigned to a waste based on the physical description of the waste and the chemical constituents. Form codes are used to determine which analytical test methods to use (if necessary), how the waste should be stored, and are also used to track the waste in the RHW database. The source code is an LLNL-specific designator that is associated with the process that generated the waste.

3.0 Waste Acceptance Guidance

3.1 General Guidance

Guidance is provided below for waste generators in identifying waste, labeling and packaging waste for safe handling and storage, and in which documentation is required. Waste certification and life-cycle planning are also discussed.

3.1.1 Waste Identification

Waste identification is required to determine which waste criteria a particular waste is required to meet. It is the responsibility of the individual waste generator to identify waste that he/she generates. Specific waste identification guidance follows.

3.1.1.1 Process Knowledge

Waste identification may be made by the Waste Generator through knowledge of the process that generated the waste. The Waste Generator will need to provide the following information: what the starting materials were, a description of the waste generating process, and the expected waste material components. This information will be documented by the RHW Technician after consulting with the Waste Generator.

3.1.1.2 Sampling and Analysis

Sampling and analysis may be used in conjunction with process knowledge to identify waste composition. The RHW Technician will provide guidance if sampling and analysis is required.

3.1.2 Packaging and Labeling

Waste containers must be properly packaged and labeled. Packaging and labeling guidelines follow.

3.1.2.1 Packaging

Waste must be packaged in the proper waste containers. Improperly packaged waste will not be accepted. The RHW Technician will assist generators in packaging waste in the appropriate containers so that the waste may be safely transported and stored by RHW.

Selecting the proper container requires knowledge of the waste, the regulations enacted to manage it, and the characteristics of the container. Detailed guidance for container selection is provided in the *Waste Analysis Plan (WAP)*, Table 8.

Typically, only containers approved by LLNL's Packaging and Transportation Safety (PATS) group are used, and PATS containers must be closed according to the manufacturer's closure instructions. There may be some instances that allow for use of non-PATS-certified containers. These instances include: reshipment of DOT-approved, product-filled containers; plastic-wrapped, non-DOT regulated equipment; and some non-DOT or non-PATS certified boxes. The RHWMT Technician can provide additional guidance.

Waste must be packaged in tightly closed containers that show no sign of damage, deterioration, bulging, or leaking. Overfilled liquid waste containers can burst or leak when exposed to summer heat during storage. To prevent this, 55-gallon drums containing liquid require a minimum of 3 inches of headspace; carboys require a minimum of 2 inches of headspace. Waste should be packaged in the smallest acceptable container in which the waste will fit; however the minimum, outer container size acceptable is 5 gallons. Waste containers less than five gallons, must be individually labeled and overpacked into a larger container. Overpacks are to have sufficient absorbent to absorb the entire contents of the overpacked liquid containers should the inner containers break open.

For solid wastes, waste should be packed to minimize void space. Liquids and solids should not be packaged together.

Bulk wastes are accepted on a case-by-case basis. Bulk solid waste may include used drums and large equipment. Bulk liquid waste is accepted in compatible RHWMT portable tanks or tankers.

Intact aerosol cans must be packaged in a manner that does not allow activation of material release mechanisms. Corrugated partitioning may be used to meet this requirement.

Reactive wastes must be packaged in a way that stabilizes the waste so that the waste does not react during transport or storage. Water reactive waste must be packaged so that the packaging prevents water infiltration. The waste containers must be tightly sealed and overpacked in PATS-certified containers with the appropriate absorbents.

Pyrophoric wastes must be segregated from LLW. Properly packaged pyrophoric materials are accepted into RHWMT facilities for treatment. Pyrophoric uranium waste must be covered with mineral oil, water or a trimsol-type solution, packaged in a vented 30-gallon container, then overpacked into a 55-gallon container.

Waste containing sharp objects presents a potential danger to RHWMT personnel. The waste description on the WDR must identify that sharp objects are present in the waste container. The sharps must be enclosed in rigid packaging. In addition, sharp objects labels must be applied to the outer container.

The waste description on the WDR for waste containing small hand tools must list the small hand tools. This requirement applies to low-level mixed or combined waste only.

3.1.2.2 Labeling

The RHWMT Technician provides the waste generator with container labels. All waste containers must be labeled, and information on the label must be consistent with the waste identification and characterization information.

Labels must be filled in and affixed to the waste container as soon as waste is added to it, and must be updated if needed. Pre-printed labels may be issued by the RCO or labels may be handwritten using the appropriate RHWMT waste-type label. Handwritten labels must be filled out legibly and accurately in indelible ink. Labels must be clearly visible on the container. An indelible, black ink, extra-fine-point, Sharpie pen (or equivalent) must be used to fill in handwritten labels. Labels filled out with other pens or colors readily fade and are not accepted by RHWMT. If label changes are necessary, remove the label from the container and prepare a new label. Do not place a new label over an old label. Lining out or whiting-out and reentering data on a waste label is not acceptable.

The waste label must be placed on the exterior of the container in the upper half of the container side (never on the lid) where it can be read. If additional containment is used for the primary container that obstructs the primary container's label, then the outer containment also needs to be labeled. When an overpacked container is used for numerous small containers, the label on the overpack needs to reflect the hazardous properties, waste descriptions, and hazardous or radioactive constituents of each container, as well as the earliest accumulation date.

Additional guidance pertaining to labeling waste containers for storage is found in *ES&H Manual*, Document 36.3, "Management of Satellite and Waste Accumulation Areas for Hazardous and Mixed Waste", Appendix B.

3.1.3 Waste Containing Beryllium

All containers of waste with beryllium, beryllium compounds, or beryllium-contaminated items must be labeled with the appropriate waste-type label (Nonhazardous, Hazardous, Radioactive, or Mixed Waste) and labeled in accordance with the *ES&H Manual*, Document 14.4, "Implementation of the Chronic Beryllium Disease Prevention Program Requirements". All waste containers from Regulated Beryllium Work Areas must be swiped and verified to meet the Free Release Criteria of less than $0.2 \mu\text{g}/100\text{cm}^2$ of beryllium surface contamination.

3.1.4 Waste Containing Asbestos

Intact nonfriable asbestos-containing waste is not considered hazardous unless the material is disturbed or deteriorates, causing loose fibers to become airborne and respirable. Asbestos that becomes friable or is friable is managed as hazardous waste when the asbestos content exceeds 1%.

Nonfriable asbestos shall be disposed of as nonfriable asbestos-containing waste. An RHWMT Technician can assist in the determination of the friability of a specific asbestos-containing waste. Friable asbestos waste must be placed in 6-mil-thick plastic bags that have been HEPA vacuumed (to remove excess air), then sealed and placed in outer plastic bags that are also 6 mil thick.

Waste generated by LLNL employees or subcontract workers is disposed of by the RHWM Division. Disposal of all hazardous asbestos waste generated by outside subcontractors shall be the responsibility of those subcontractors. Written authorization is required from the RHWM Division before waste can be shipped offsite for disposal.

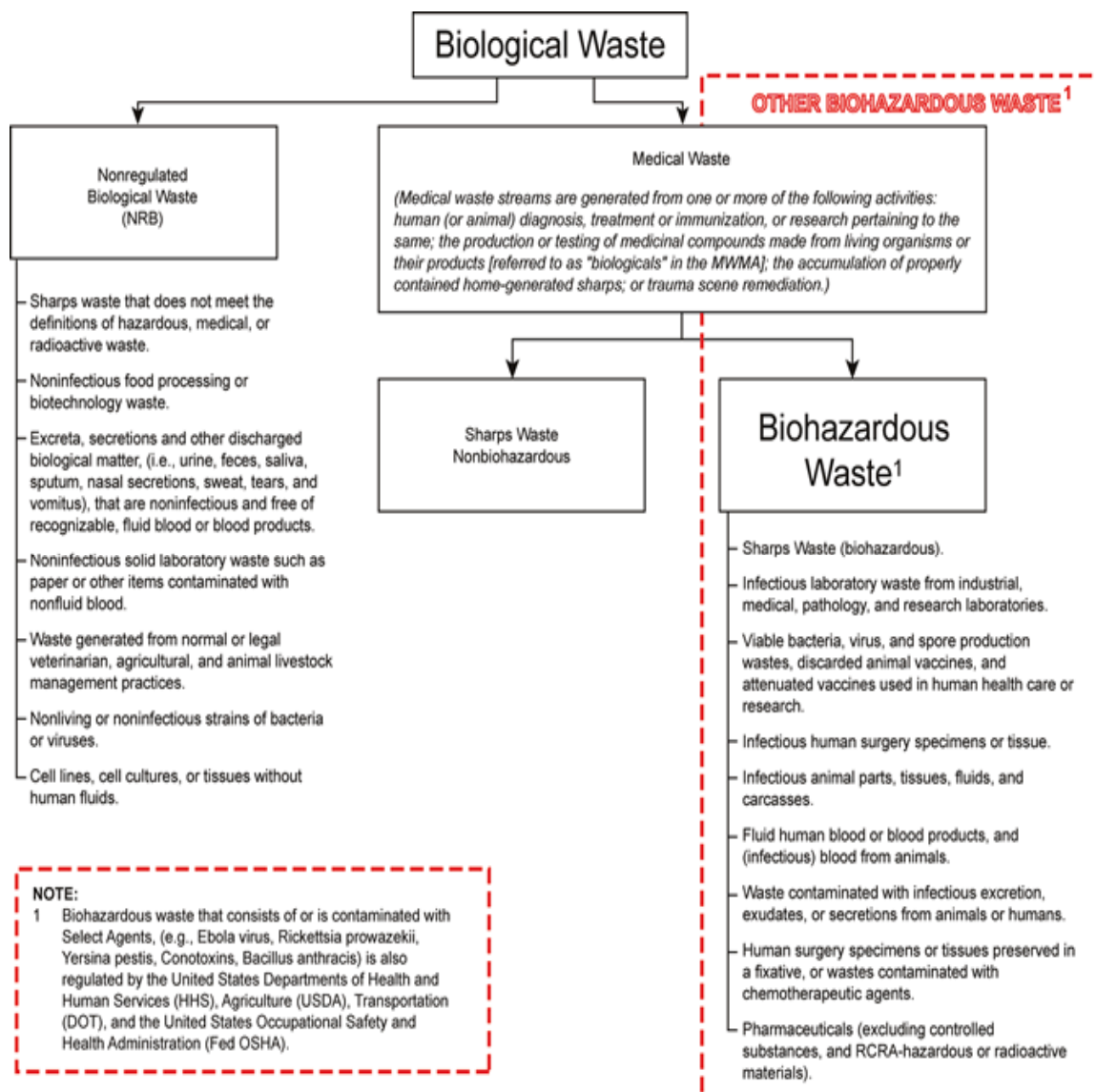
Further guidance pertaining to the management of asbestos containing materials is found in section 3.2.2.2 below and also in the *ES&H Manual*, Document 14.9, “Safe Handling of Asbestos-Containing Material During Construction Work”.

3.1.5 Waste Containing Polychlorinated Biphenyls (PCBs)

Specific information pertaining to the management of PCB waste is found sections 3.2.1.8, 3.2.2.11, and 3.2.3.5 below and in the *ES&H Manual*, Document 14.14, “Management of Polychlorinated Biphenyls”.

3.1.6 Biological Materials

Biological waste consists of waste types generated from biological research (e.g., lab debris, sharps, cultures) that contain or are contaminated with biological components and that do **not** contain state or federal hazardous or radioactive constituents above regulatory thresholds. Table 2 gives a summary of biological material waste types.

Table 2. Summary of Biological Material Waste Types.

Nonregulated Biological wastes (NRB) that are amenable to steam-sterilization and do not contain chemical or radiological components are autoclaved. NRB sharps wastes are accumulated as nonhazardous waste at both the Livermore site and at Site 300 and should be labeled as "Nonhazardous". Examples of NRB wastes include: nonliving, noninfectious strains of bacteria or viruses; uninfected animal blood; noninfectious cell lines, cell cultures or tissues without human fluids; molds; and noninfectious DNA and RNA. NRB waste should be accumulated in clear bags capable of withstanding high temperatures. Autoclaving is the primary treatment option for NRB sharps waste, followed by offsite incineration.

Medical waste may be generated from various sources including testing of medicinal compounds and human or animal research. Examples of medical waste include: cultures or stocks of infectious agents; human blood; and pharmaceuticals. Medical waste must be accumulated in red bags (or rigid containers for sharps). A "biohazard" label and an "Incinerate Only" label

must be placed on all four sides of the waste container. In addition, recordkeeping requirements include keeping a generator logbook and autoclave records.

Specific information pertaining to biological waste materials is given in sections 3.2.1.2 and 3.2.2.1 below and also in the *ES&H Manual*, Document 13.1, “Biological Controls and Operations”, and Document 36.1, “Hazardous, Radioactive, and Biological Waste Management Requirements”.

3.1.7 Chemical Exchange Warehouse

RHWM maintains the Chemical Exchange Warehouse (CHEW). When a Waste Generator no longer has a use for a chemical, CHEW may be able to accept it instead of the Waste Generator declaring it as waste. Acceptance of a chemical by CHEW is based on the potential for re-use of the chemical at LLNL. CHEW personnel will evaluate and pick up chemicals, temporarily store them, list them on a lab-wide database, and deliver the chemicals to someone who can use them. Both opened and unopened containers are accepted at CHEW, provided materials are pure, in the original manufacturer’s containers, the container is clean, and the chemical is safe for RHWM staff to handle. Radioactive material or chemicals that are contaminated with radioactive material are not accepted by CHEW.

For more information, the CHEW website is found at http://chemtrack.llnl.gov/synnp/form_chew.startup.

3.1.8 Documentation

Specific documentation needs to be in place prior to the acceptance of waste by RHWM, as noted in the following sections.

3.1.8.1 Waste Disposal Requisition (WDR)

The WDR is used to document information about the waste in a specific waste container. This information is needed to comply with state and federal regulations and LLNL requirements and also to determine treatment, storage, disposal, and transportation requirements. WDR requirements are documented in RHWM Procedure WIC 116, *Waste Disposal Requisition Requirements*.

3.1.8.2 Information Gathering Document (IGD)

An IGD is required to document information pertaining to waste stream generation. The IGD documents process knowledge and is also used to characterize waste streams by providing information on the waste generating process and the expected waste constituents and concentrations which will be generated. An IGD is not required for: overpacks or labpacks of unused materials; unused products or reagents; berm waters; empty containers; CHEW items; retention tank liquids; in process waste; leaking capacitors; mercury thermometers; light ballasts; asbestos abatement waste; batteries; fluorescent light tubes; accumulation containers; or containers with bulked or blended wastes.

IGD requirements are documented in RHW M Procedures WIC 142, *Processing IGDs for Waste with a Radioactive Component*, and WIC 146, *Processing IGDs for Waste Containing Hazardous-only Components*.

3.1.8.3 Fingerprint Verification Analysis Checklist (FVAC)

The Fingerprint Verification Analysis Checklist (FVAC) is used by RHW M to verify waste identification in the field by performing screening tests and chemical analyses. Completion of an FVAC is not required for labpacks.

FVAC requirements are documented in RHW M Procedure WIC 103, *Field Fingerprint Verification Process*.

3.1.9 Life-Cycle Planning

Life-cycle planning, must be completed to address any potential issues which may arise with a waste, for waste that has a radioactive component. A plan must be in place to address the management of waste throughout the entire life-cycle of the waste, from generation to disposal. The DOE Order 435.1 stipulates that no radioactive waste shall be generated unless a disposal path has been identified first and specifies requirements for life-cycle planning. Any exceptions to the Order must be approved by DOE. Prior to generating waste which may contain a radioactive component, the Waste Generator must work with RHW M to determine if a feasible disposal path exists for the proposed waste to be generated. Life-cycle planning assessments are completed in accordance with RHW M Procedure WIC 117, *Life-Cycle Planning*. Once the new process is evaluated, one of three options for the waste will be identified. These include:

- Waste with a Disposal Path and Disposal Option -Waste that meets the acceptance criteria of a disposal facility and the disposal facility has agreed to accept the waste.
- No Identified Path to Disposal - Waste that does not meet the acceptance criteria for any disposal facility, even after treatment.
- No Disposal Option - Waste meets the acceptance criteria of a given disposal facility; however, the cost is prohibitive for characterization, treatment, transportation, disposal, and/or technology development.

The DOE must approve the generation of any waste that is deemed to have No Identified Path to Disposal.

3.1.10 Waste Certification

In response to DOE concerns about wastes shipped from DOE sites, and in accordance with DOE Order 435.1, LLNL has a waste certification process to ensure that all of its wastes are accurately characterized, especially for those operations that generate radioactive waste. Waste certification compares a waste item to a specific set of waste certification criteria and verifies that the item meets those criteria. LLNL personnel must characterize waste to meet requirements stipulated in DOE Order 435.1 and in sufficient detail to conform with the requirements of the intended disposal site. All waste with a radioactive component is certified for disposal. Waste disposal sites require waste to be certified prior to acceptance.

3.2 Specific Waste Handling Guidance

Guidelines for acceptance of waste by RHW by waste type are found below. There may be other waste stream specific criteria that should be addressed prior to waste generation. Deviations from these acceptance criteria require special approval or an exception as described in Section 1.6.

In general, most aqueous radioactive liquids are treated on-site. As long as labeling and packaging guidelines are properly followed, this type of waste will be accepted into RHW facilities.

3.2.1 Waste With Hazardous-Only Constituents

Hazardous waste is defined as waste that is determined by the EPA or by the State of California to be hazardous and pose a danger to public health, safety, or the environment. Guidelines for hazardous waste acceptance are described in the following sections.

3.2.1.2 Biological Material (Including Animals)

Animals and animal parts must either be frozen or placed in a preservative such as formalin. Whole animals should be segregated from animal parts. Hazardous animals and animal parts should be separated from non-hazardous. In addition, this waste must be segregated and packaged in accordance with the current packaging instructions for acceptance.

3.2.1.3 Drug Precursors

RHW can accept drug precursors (as waste) into its storage facilities upon completion of a WDR. Drug precursors are intermediate compounds from which a more stable product (drug) could be formed.

3.2.1.4 Fluorescent Tubes and Ballasts

Fluorescent tubes and ballasts must be segregated and packaged separately. If the waste is generated from a Radioactive Materials Management Area (RMMA) contamination control procedures must be followed. The RHW Technician may provide guidance.

3.2.1.5 Fuming Acids

Fuming acids, except hydrofluoric acid, shall be packaged in DOT-approved glass containers with sealable caps in order to be accepted. Hydrofluoric acid must be packaged in a plastic container. The RHW Technician may provide guidance.

3.2.1.6 Gas Cylinders

Generators should return empty gas cylinders to the manufacturer through Industrial Gases. If return is not possible, the Waste Generator must contact the RHWMT Technician to have the cylinder(s) evaluated. Cylinders must meet DOT criteria or have a DOT cylinder overpack. Cylinders must be closed and have a threaded plug or cap over the outlet.

3.2.1.7 High Efficiency Particulate Air (HEPA) Filters

When a HEPA filter is removed from service and becomes waste, the generator must provide information about the type of process in which it was used.

3.2.1.8 Polychlorinated Biphenyls (PCBs)

Some hazardous wastes are governed by laws in addition to or other than HWCL or RCRA. One example is polychlorinated biphenyl (PCB) waste. PCB wastes are regulated by the Federal Toxic Substances Control Act (TSCA) under certain conditions. PCBs are persistent chemicals which resist metabolic processes that would break them down to simpler chemical compounds and are considered to be probable human carcinogens by the Environmental Protection Agency (EPA). Any waste containing PCBs must be segregated from other waste streams. PCB wastes are categorized according to the concentration of PCBs present.

PCB Classifications	
≥ 500 ppm	PCB
≥ 5 to < 500 ppm	PCB Contaminated
≥ 50 ppm	PCB Contaminated: TSCA-Federal regulated
≥ 5 to < 49 ppm	PCB Contaminated: California-State regulated
< 5 ppm	Non-PCB

Wastes with mixtures of PCB-containing materials are subject to the requirements of the highest concentration classification of the mixture. PCB waste must be disposed of within one year from the date when it is declared waste. Waste contaminated with PCBs greater than 50 ppm may require special handling or storage time restrictions.

Further information pertaining to PCB wastes may be found in the *ES&H Manual*, Document 14.14, "Management of Polychlorinated Biphenyls".

3.2.1.9 Medical Waste

Medical waste must be autoclaved or disinfected as described in the *ES&H Manual*, Document 36.1, "Hazardous, Radioactive, and Biological Waste Management Requirements", prior to acceptance.

3.2.1.10 Nitric Acid

Depending upon concentration, nitric acid may require special packaging so that the SCIL is not exceeded. Nitric acid greater than 70% requires special packaging (composite drum or stainless) as required by DOT. The RHWM Technician may provide assistance in determining the proper handling of nitric acid waste.

3.2.1.11 Peroxide-forming Materials

Wastes that may form peroxides or peroxide crystals must be tested to determine the peroxide content. The RHWM Technician may be contacted to arrange for testing. As a safety precaution, do not handle or move the waste container unnecessarily. The *ES&H Manual*, Document 14.1, "LLNL Chemical Safety Management Program", Section 3.7.3 can provide further guidance.

3.2.2 Waste With Low-Level Radioactive-Only Constituents

The implementation of this WAC will ensure that waste management activities at LLNL are conducted in compliance with the requirements of DOE Order 435.1, *Radioactive Waste Management*, and the Implementation Guide for DOE Manual 435.1-1, *Radioactive Waste Management Manual*.

Low-level radioactive waste is defined as radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, or by product material (as defined in Section 11e (2) of the Atomic Energy Act of 1954 as amended).

LLW cannot contain any hazardous waste constituents or exhibit any hazardous waste characteristics (e.g., toxicity, corrosivity, ignitability, or reactivity). It is the generator's responsibility to provide sufficient information to demonstrate the waste is not hazardous waste.

3.2.2.1 Biological Materials (Including Animals)

Animals and animal parts must either be frozen or placed in a non-hazardous preservative. Whole animals should be segregated from animal parts. Radioactive animals and animal parts must be segregated from non-radioactive animals and animal parts.

3.2.2.2 Asbestos Containing Material

Radioactive, friable asbestos waste at a concentration greater than 1% by weight must be packaged separately. Also, friable asbestos must be segregated from Nevada Test Site (NTS) certified LLW. The RHWM Technician may offer some guidance in how to deal with asbestos containing wastes. Further guidance may be found in the *ES&H Manual*, Document 14.9, "Safe Handling of Asbestos-Containing Material During Construction Work".

3.2.2.3 Chelating Agents

Chelating agents are chemicals that combine with metal ions to form stable and soluble molecules. Reactions with ions of radioactive metal ions increase the mobility of these ions, which could increase the chance of their release to the environment. Waste that is destined for disposal at the Nevada Test Site (NTS) must contain less than 1% chelating agents.

3.2.2.4 Classified Waste

Classified solid LLW may be shipped directly from generator locations. If waste is de-classified, it will be accepted into RHWM facilities.

3.2.2.5 Etiological Agents

Waste containing etiological agents, such as pathogens or infectious waste, is not accepted.

3.2.2.6 Explosives

LLW shall not contain explosives.

3.2.2.7 Gases

Compressed gases, aerosol cans and chemicals capable of generating gases or causing generation of liquids or vapors harmful to persons handling the containers are not allowed in low-level radioactive waste.

3.2.2.8 HEPA Filters

When a HEPA filter is removed from service and becomes waste, the generator must provide information about the type of process in which it was used.

3.2.2.9 Liquids

The amount of free liquids in solid LLW containers must be kept to a minimum. If there is a potential for liquid release, an absorbent must be added to the container to absorb any liquid that could be released within the container.

3.2.2.10 Particulates

Particulates must be immobilized if more than one weight percent of the waste matrix consists of particles below 10 micrometers in diameter, or if more than 15 weight percent consists of particles below 200 micrometers in diameter. Waste that could be converted to a particulate during handling must be immobilized. To immobilize particulates, package them in 6 mil plastic or greater, prior to placing waste into container.

3.2.2.11 Polychlorinated Biphenyls (PCBs)

The concentration of PCBs in LLW waste must be less than 5 ppm.

3.2.2.12 Pyrophorics

LLW must not contain material in a form that could spontaneously explode or combust if the container is breached. Properly packaged pyrophoric materials are accepted into RHWL facilities for treatment.

Pyrophoric uranium waste must be covered with water, mineral oil, trimsol, or a water/trimsol mixture and packaged in a vented 30-gallon container, then overpacked into a 55-gallon container. Other pyrophoric materials must be evaluated on a case-by-case basis.

3.2.2.13 Accountable Nuclear Materials

Special training is required to transfer waste from a Materials Balance Area (MBA) to RHWL. Various requirements must be satisfied prior to the movement of nuclear material from one LLNL location to another onsite location. The area MBA representative must be contacted for assistance.

3.2.2.14 Contamination Control

The exterior container must be swiped to verify that it meets contamination control guidelines for release from radiologically controlled areas. For further guidance, see the *ES&H Manual*, Document 20.2, "LLNL Radiological Safety Program for Radioactive Materials".

3.2.2.15 Dose Rate

The combined beta, gamma, and neutron dose rate anywhere on the surface of a LLW waste container may not exceed 200 mrem/hr (the "contact-handled" limit).

3.2.2.16 Greater than Class A Waste

Waste with a radioactive component that is categorized as Class B or Class C waste is only accepted on a limited basis. Waste that is categorized as Greater than Class C (GTCC) is only accepted on a case-by-case basis and may require an exemption request prior to acceptance. GTCC is waste having concentrations of certain radionuclides above the Class C limits as stated in 10 CFR 61.55 (<http://www.access.gpo.gov/nara/cfr>). Prior to generating this type of waste, the RHWL Technician should be consulted to verify that the waste has a disposal option/path prior to proceeding.

3.2.3 Transuranic Waste

TRU mixed waste must not exhibit the characteristics of reactivity, corrosivity, or ignitability. TRU Wastes that are classified, explosive and/or gases in compressed gas cylinders are not accepted.

3.2.3.1 Contamination Control

The exterior of each waste container must be swiped to verify that it meets contamination control guidelines for release from radiologically controlled areas. For further guidance, see the *ES&H Manual*, Document 20.2, “LLNL Radiological Safety Program for Radioactive Materials”.

3.2.3.2 Gas Generation

Gas generation by radiolytic decomposition of hydrogen-containing materials is of concern in the transport and storage of radioactive waste. There is the potential for generation of explosive gases, including hydrogen, in waste containers. To minimize the confinement of these gases in waste containers, generators should reduce, to the maximum extent possible, the number of hydrogen gas confinement layers in the waste container (e.g., plastic bags). The RHWMT Technician may be able to provide assistance.

3.2.3.3 Heat Generation

Internal heat generation produced by radioactive decay must not cause damage to the integrity of the container. There are specific calculations needed for decay heat that must be done for waste that is to be certified TRU. The RHWMT Technician may be able to provide assistance.

3.2.3.4 Liquids

Liquids must not be packed with solid TRU waste. Containers that previously held liquids must be well drained and must have absorbant added. TRU liquid waste may be accepted for treatment on a very limited basis. Pre-approval is required. The RHWMT Technician may be able to provide assistance.

3.2.3.5 Polychlorinated Biphenyls (PCBs)

Any waste suspected of containing PCBs must be segregated. Waste contaminated with PCBs greater than or equal to 50 ppm will be accepted on a limited basis. The RHWMT Technician may be able to provide assistance.

3.2.3.6 Pyrophorics

TRU waste containing pyrophoric materials will not be accepted.

3.2.3.7 Sealed Rigid Containers

Internal sealed rigid containers greater than four liters, inside of a waste container will not be accepted as a component of waste. Any internal sealed container must be less than four liters. Bags that have been heat-sealed are considered to be a "sealed rigid container" and if they are greater than 4 liters in volume, are not allowed in TRU waste.

3.2.3.8 Accountable Materials

Before transferring waste with accountable material from a Materials Balance Area (MBA) to RHW, certain requirements must be met and documentation must be completed. The area MBA Representative and the RHW Technician may provide assistance.

3.2.3.9 Dose Rate

The combined beta, gamma, and neutron dose rate anywhere on the surface of a TRU waste container may not exceed 200 millirem per hour (the "contact-handled" limit). Note that a neutron survey of the container surface is required for TRU waste.

3.2.3.10 Radiological Composition

An RHW representative will provide assistance in calculating the radiological composition of waste in accordance with RHW procedures and disposal site waste acceptance criteria. Waste Generators should consult with Section 2.2.1 to verify that the waste meets the radiological limits for acceptance by RHW.

3.2.4 Mixed Waste and California-combined Waste

Mixed Waste is radioactive waste that contains a RCRA hazardous constituent. Waste may become mixed waste (1) as a product of an experiment or procedure; (2) due to exposure of RCRA hazardous waste to unconfined sources of radioactivity to the point that the waste becomes radioactive; or (3) improper waste segregation.

California-combined waste is waste that meets the definition of LLW and also contains only State of California regulated hazardous constituents above regulatory limits (is free of RCRA hazardous waste constituents above regulatory limits).

The same waste acceptance guidelines given in Section 3.2 should be followed for mixed waste and California-combined waste. Characterization, treatment, and disposal of mixed and California-combined waste is costly so generation of these waste types must be minimized if at all possible.

3.2.5 Non-Hazardous and Non-Radioactive Waste

Non-hazardous waste is waste that contains no RCRA or California regulated hazardous constituents, or waste that contains RCRA and California regulated hazardous constituents in

amounts that are below threshold regulated hazardous waste limits. Asbestos that is friable or becomes friable is hazardous waste if the asbestos content exceeds 1%.

Retention tank water must be sampled and analyzed in accordance with wastewater guidance from the EPD Water Guidance and Monitoring Group (WGMG) to ensure that it meets sewer release limits. RHW must be contacted prior to release of retention tank water to ensure that any analysis and/or documentation that may be required have been completed.

Non-radioactive waste is waste with no radiological constituents added by LLNL activities. While virtually all materials are radioactive because they contain natural radionuclides, or are contaminated with artificial radionuclides from non-controllable sources (e.g., fallout), regulatory controls do not apply to such materials. Primordial radionuclides (e.g. ^{40}K , ^{87}Rb , ^{238}U , and ^{232}Th) exist naturally in the environment (soil, rocks, air, water, foodstuffs). Cosmogenic radionuclides (e.g., ^3H , ^{14}C , ^7Be , and ^{22}Na) and fallout radionuclides (^{137}Cs and ^{90}Sr) are also found in the natural environment. The presence of such radionuclides in concentrations normally found in the environment, does not make a waste material radioactive, for the purposes of regulatory control. Where analyses determine that the radionuclides detected are naturally occurring and within the normal range of variation for that radionuclide in the specific material being analyzed, the material is not considered to be radioactive for the purpose of disposal.

4.0 References

California Code of Regulations. *Identification and Listing of Hazardous Waste*, 22 CCR sections 66261.1-66261.126, latest revision.

Code of Federal Regulations. *Operators' Licenses*, 10 CFR 55, latest revision.

Code of Federal Regulations. *Identification and Listing of Hazardous Waste*, 40 CFR 261, latest revision.

LLNL. *Documented Safety Analysis for the Waste Storage Facilities*, UCRL-AR-202270, latest revision.

LLNL. *ES&H Manual*, Document 2.1, "General Worker Responsibilities and Integrated Safety Management," Appendix D, latest revision.

LLNL. *ES&H Manual*, Document 13.1, "Biological Controls and Operations," latest revision.

LLNL. *ES&H Manual*, Document 14.4, "Implementation of the Chronic Beryllium Disease Prevention Program Requirements," latest revision.

LLNL. *ES&H Manual*, Document 14.9, "Safe Handling of Asbestos-Containing Material During Construction Work," latest revision.

LLNL. *ES&H Manual*, Document 14.14, "Management of Polychlorinated Biphenyls," latest revision.

LLNL. *ES&H Manual*, Document 36.1, "Hazardous, Radioactive, and Biological Waste Management Requirements," latest revision.

LLNL. *ES&H Manual*, Document 36.3, "Management of Satellite and Waste Accumulation Areas for Hazardous and Mixed Waste," Appendix B, latest revision.

LLNL. *ES&H Manual*, Document 40.1, "LLNL Training Program Manual," latest revision.

LLNL. *Facility Safety Plan for the Waste Storage Facilities and B696S*, March 2006.

LLNL. *Part B Permit Application for Hazardous Waste Treatment and Storage Facilities Livermore Site*, UCRL-AR-10275, July 2004.

RHWM Division. Controlled Form WGS0002, *Information Gathering Document (IGD)*, latest revision.

RHWM Division. Standard Operating Procedure WIC 103, *Field Fingerprint Verification Process*, latest revision.

RHWM Division. Standard Operating Procedure WIC 116, *Waste Disposal Requisition Requirements*, latest revision.

RHWM Division. Standard Operating Procedure WIC 117, *Life-Cycle Planning*, latest revision.

RHWM Division. Standard Operating Procedure WIC 142, *Processing IGDs for Waste with a Radioactive Component*, latest revision.

RHWM Division. Standard Operating Procedure WIC 146, *Processing IGDs for Waste Containing Hazardous-only Components*, latest revision.

U.S. Department of Energy. *Radioactive Waste Management*, DOE O 435.1, latest revision.

U.S. Department of Energy. *Radioactive Waste Management Manual*, DOE M 435.1-1, Change 1, latest revision.

Appendix A

Thresholds for Radionuclides

Adapted from: DOE-STD-1027-92, Attachment 1, Table A.1, Category 2, "Thresholds for Radionuclides"

Isotope	Curie Limit *	Gram Limit
H-3	3.0 E+05	3.0 E+01
C-14	1.4 E+06	3.1 E+05
Na-22	6.3 E+03	1.0 E+00
P-32	4.4 E+03	1.5 E-04
P-33	3.0 E+04	1.9 E-01
P-32** in acid	2.2 E+06	7.7 E-02
P-33** in acid	1.5 E+07	9.6 E+01
S-35	2.5 E+04	5.8 E-01
Cl-36	1.4 E+03	4.3 E+04
K-40	4.7 E+03	6.8 E+08
Ca-45	4.7 E+06	2.6 E+02
Ca-47	4.8 E+06	7.8 E+00
Sc-46	1.4 E+06	4.0 E+01
Ti-44	3.2 E+04	1.9 E+02
V-48	3.0 E+06	1.8 E+01
Cr-51	1.0 E+08	1.1 E+03
Mn-52	4.0 E+06	8.8 E+00
Fe-55	1.1 E+07	4.6 E+03
Fe-59	1.8 E+06	3.7 E+01
Co-60	1.9 E+05	1.7 E+02
Ni-63	4.5 E+06	8.0 E+04
Zn-65	1.6 E+06	1.9 E+02
Ge-68	5.8 E+05	8.8 E+01
Se-75	3.4 E+05	2.4 E+01
Kr-85	2.8 E+07	7.2 E+04
Sr-89	7.7 E+05	2.7 E+01
Sr-90	2.2 E+04	1.6 E+02
Y-91	6.5 E+05	2.7 E+01
Zr-93	8.9 E+04	3.6 E+07
Zr-95	1.5 E+06	6.9 E+01
Nb-94	8.6 E+04	4.6 E+05
Mo-99	7.8 E+06	1.6 E+01
Tc-99	3.8 E+06	2.3 E+08
Ru-106	6.5 E+03	1.9 E+00
Ag-110m	5.3 E+05	1.1 E+02
Cd-109	2.9 E+05	1.1 E+02
Cd-113	1.8 E+04	5.3 E+16
In-114m	3.7 E+05	1.6 E+01
Sn-113	3.2 E+06	3.2 E+02
Sn-123	9.5 E+05	1.2 E+02
Sn-126	3.3 E+05	1.2 E+07
Sb-124	1.3 E+06	7.5 E+01
Sb-126	2.5 E+06	3.0 E+01
Te-127m	1.5 E+05	1.6 E+01
Te-129m	1.4 E+05	4.7 E+00
I-125	2.4 E+03	1.4 E-01
I-131	1.8 E+03	1.4 E-02
Xe-133	1.8 E+06	9.6 E+00

Isotope	Curie Limit *	Gram Limit
Cs-134	6.0 E+04	4.6 E+01
Cs-137	8.9 E+04	1.0 E+03
Ba-133	4.0 E+06	1.6 E+04
Ba-140	7.8 E+06	1.1 E+02
Ce-141	3.3 E+06	1.2 E+02
Ce-144	8.2 E+04	2.6 E+01
Pm-145	1.1 E+06	7.6 E+03
Pm-147	8.4 E+05	9.0 E+02
Sm-151	9.9 E+05	3.7 E+04
Eu-152	1.3 E+05	7.5 E+02
Eu-154	1.1 E+05	4.2 E+02
Eu-155	7.3 E+05	1.6 E+03
Gd-153	1.4 E+06	3.9 E+02
Tb-160	1.3 E+06	1.1 E+02
Ho-166m	4.0 E+04	2.2 E+04
Tm-170	1.2 E+06	2.1 E+02
Hf-181	2.2 E+06	1.3 E+02
Ir-192	1.2 E+06	1.3 E+02
Au-198	9.3 E+06	3.8 E+01
Hg-203	4.3 E+05	3.1 E+01
Pb-210	2.2 E+03	2.9 E+01
Bi-207	2.2 E+06	4.3 E+04
Bi-210	1.5 E+05	1.2 E+00
Po-210	3.5 E+02	7.8 E-02
Rn-222	1.6 E+08	1.1 E+03
Ra-223	3.8 E+03	7.4 E-02
Ra-224	9.9 E+03	6.1 E-02
Ra-225	3.8 E+03	9.6 E-02
Ac-225	2.9 E+03	4.9 E-02
Ac-227	4.3 E+00	5.9 E-02
Th-228	9.2 E+01	1.1 E-01
Th-230	8.9 E+01	4.4 E+03
Th-232	1.8 E+01	1.6 E+08
U-233	2.2 E+02 ***	2.3 E+04***
U-234	2.2 E+02	3.5 E+04
U-235	2.4 E+02***	1.1 E+08***
U-238	2.4 E+02	7.1 E+08
Np-237	5.8 E+01	8.3 E+04
Np-238	9.1 E+05	3.5 E+00
Pu-238	6.2 E+01	3.6 E+00
Pu-239	5.6 E+01***	9.0 E+02***
Pu-241	2.9 E+03	2.8 E+01
Am-241	5.5 E+01	1.6 E+01
Am-242m	5.6 E+01	5.8 E+00
Am-243	5.5 E+01	2.8 E+02
Cm-242	1.7 E+03	5.1 E-01
Cm-245	5.3 E+01	3.1 E+02
Cf-252	2.2 E+02	4.1 E-01

* For isotopes not listed: Alpha emitters - 5.5 E+01 Ci; Beta emitters - 4.3 E+05 Ci; Mixed fission products - 1.0 E+03 Ci.

** When used in an acidic solution these isotopes are no longer considered highly volatile.

*** To be used only if segmentation or nature of process precludes potential for criticality. Otherwise, use the criticality values for U-233, U-235, and Pu-239 of 500, 700, and 450 grams respectively.

Appendix B

Acronyms

AEA	Atomic Energy Act
CC	Characterization Chemist
CCR	California Code of Regulations
CFR	Code of Federal Regulations
CHEW	Chemical Exchange Warehouse
DOE	Department of Energy
DOT	Department of Transportation
DSA	Documented Safety Analysis
EA	Environmental Analyst
EPA	Environmental Protection Agency
EPD	Environmental Protection Department
ES&H	Environment, Safety & Health
FVAC	Fingerprint Verification Analysis Checklist
HEPA	high efficiency particulate air
HWCL	Hazardous Waste Control Law
IGD	information gathering document
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
MBA	Materials Balance Area
Nat-U	natural uranium
NRB	nonregulated biological waste
NTS	Nevada Test Site
PATS	Packaging and Transportation Safety
PCBs	polychlorinated biphenyls
PE-Ci	plutonium equivalent curie
RCA	Radiological Characterization Chemist
RCO	Requisitions Control Office
RCRA	Resource Conservation and Recovery Act
RHWM	Radioactive and Hazardous Waste Management
RMMA	Radioactive Materials Management Area
SAA	Satellite Accumulation Area
SCAL	single container activity limits
SCIL	single container inventory limits

TRU	transuranic
TSCA	Toxic Substances Control Act
WAA	Waste Accumulation Areas
WAC	Waste Acceptance Criteria
WAP	Waste Analysis Plan
WCP	Waste Certification Program
WDR	Waste Disposal Requisition
WGMG	Water Guidance and Monitoring Group
WSS	Work Smart Standards